7203/4CX250B

Beam Power Tube

FORCED-AIR COOLED

CERAMIC-METAL SEALS — **400 WATTS CW OUTPUT TO 175 Mc**
COAXIAL-ELECTRODE STRUCTURE — **250 WATTS CW OUTPUT AT 500 Mc**
COMPACT DESIGN — **INTEGRAL RADIATOR**

For Use at Frequencies up to 500 Mc

The 7203 is unilaterally interchangeable with the 4X250B and bilaterally interchangeable with the 4CX250B.

GENERAL DATA

Electrical:

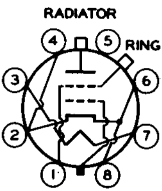
Heater, for Unipotential Cathode:		
Voltage (AC or DC)[a]	6.0 ± 10%	volts
Current at heater volts = 6.0	2.6	amp
Minimum heating time.	30	sec
Mu-Factor, Grid No.2 to Grid No.1, for grid-No.2 volts = 300 and grid-No.2 ma. = 50.	5.0	←
Direct Interelectrode Capacitances:[b]		
Grid No.1 to plate.	0.03	μμf
Grid No.1 to cathode, grid No.2, and heater.	16.0	μμf
Plate to cathode, grid No.2, and heater.	4.4	μμf

Mechanical:

Operating Position.	Any
Maximum Overall Length.	2.464"
Maximum Seated Length	1.91" ←
Maximum Diameter.	1.640"
Weight (Approx.).	4 oz
Radiator.	Integral part of tube
Socket.	Air-System Socket, such as SK-600[c] and SK-606 Air Chimney[c]; or 124-110-1[d] (Supplied with Air Chimney)
Base.	Special 8-Pin

BOTTOM VIEW

Pin 1 - Grid No.2[e]
Pin 2 - Cathode
Pin 3 - Heater
Pin 4 - Cathode
Pin 5 - Do Not Use
Pin 6 - Cathode
Pin 7 - Heater



Pin 8 - Cathode
Base Index Plug - Grid No.1
Radiator - Plate
Ring Terminal[f] - Grid No.2

Air Flow:
Through indicated air-system socket—This fitting directs the air over the base seals; past the grid-No.2 seal, envelope, and plate seal; and through the radiator to

← Indicates a change.

provide effective cooling with minimum air flow. When the tube is operated at maximum plate dissipation for each class of service, a minimum air flow of 3.8 cfm through the system is required. The corresponding pressure drop is approximately 0.3 inch of water. These requirements are for operation at sea level and at an ambient temperature of 20° C. At higher altitudes and ambient temperatures, the air flow must be increased to maintain the respective seal temperatures and the plate temperature within maximum ratings.

Without air-system socket—If an air-system socket is not used, it is essential that adequate cooling air be directed over the base seals, past the envelope, and through the radiator. Under these conditions and with the tube operating at maximum plate dissipation for each class of service, a minimum air flow of 3.6 cfm must pass through the radiator. The corresponding pressure drop is approximately 0.1 inch of water. These requirements are for operation at sea level and at an ambient temperature of 20° C. At higher altitudes and ambient temperatures, the air flow must be increased to maintain the respective seal temperatures and the plate temperature within maximum ratings.

Plate Temperature (Measured on base end of plate surface at junction with fins)	250 max.	°C
Temperature of Plate Seal, Grid-No.2 Seal, and Base Seals	250 max.	°C

AF POWER AMPLIFIER & MODULATOR — Class AB_1[g]

Maximum CCS[h] Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT[j]	250 max.	ma
GRID-No.2 INPUT[j]	12 max.	watts
PLATE DISSIPATION[j]	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

Values are for 2 tubes

DC Plate Voltage	1000	1500	2000	volts
DC Grid-No.2 Voltage	350	350	350	volts
DC Grid-No.1 (Control-grid) Voltage	-55	-55	-55	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage	94	94	94	volts
Zero-Signal DC Plate Current	166	166	166	ma
Max.-Signal DC Plate Current	500	500	500	ma

Zero-Signal DC Grid-No.2 Current	0	0	0	ma
Max.-Signal DC Grid-No.2 Current (Approx.)	10	8	8	ma
Effective Load Resistance (Plate to plate)	3300	6000	8700	ohms
Max.-Signal Driving Power (Approx.)	0	0	0	watts
Max.-Signal Power Output (Approx.)	220	400	590	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance (Per tube) . 0.1 max. megohm

RF POWER AMPLIFIER — Class B Television Service

Synchronizing-level conditions per tube unless otherwise specified

Maximum CCS[h] Ratings, *Absolute-Maximum Values:*

	54 to 216 Mc	
DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	-250 max.	volts
DC PLATE CURRENT (AVERAGE)[k]	250 max.	ma
GRID-No.2 INPUT	12 max.	watts
GRID-No.1 INPUT	2 max.	watts
PLATE DISSIPATION	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode.	150 max.	volts
Heater positive with respect to cathode.	150 max.	volts

Typical CCS Operation:

With bandwidth of 5 Mc

DC Plate Voltage	1000	1500	2000	volts
DC Grid-No.2 Voltage	350	350	350	volts
DC Grid-No.1 Voltage	-60	-65	-70	volts
Peak RF Grid-No.1 Voltage:				
Synchronizing level	65	71	76	volts
Pedestal level	52	57	62	volts
DC Plate Current:				
Synchronizing level	355	360	360	ma
Pedestal level	250	250	250	ma
DC Grid-No.2 Current:				
Synchronizing level	27	29	29	ma
Pedestal level	4	0	0	ma
DC Grid-No.1 Current:				
Synchronizing level	2	5	5	ma
Pedestal level	0	0	0	ma
Driving Power (Approx.):[l]				
Synchronizing level	0.4	1.2	1.2	watts
Pedestal level	0	0	0	watts
Power Output (Approx.):				
Synchronizing level	160	300	440	watts
Pedestal level	90	170	250	watts

LINEAR RF POWER AMPLIFIER
Single-Sideband Suppressed-Carrier Service

Maximum CCS[h] Ratings, *Absolute-Maximum Values:*

	Up to 500 Mc	
DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	400 max.	volts
MAX.-SIGNAL DC PLATE CURRENT	250 max.	ma
GRID-No.2 INPUT	12 max.	watts
PLATE DISSIPATION	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Class AB_1 "Single-Tone" Operation:[m]

At frequencies up to 175 Mc

DC Plate Voltage	1000	1500	2000	volts
DC Grid-No.2 Voltage[n]	350	350	350	volts
DC Grid-No.1 (Control-grid) Voltage	-55	-55	-55	volts
Zero-Signal DC Plate Current	83	83	83	ma
Zero-Signal DC Grid-No.2 Current	0	0	0	ma
Effective RF Load Resistance	1650	3000	4350	ohms
Max.-Signal DC Plate Current	250	250	250	ma
Max.-Signal DC Grid-No.2 Current	5	4	4	ma
Max.-Signal Peak RF Grid-No.1 Voltage	47	47	47	volts
Max.-Signal Driving Power (Approx.)	0	0	0	watts
Max.-Signal Power Output (Approx.)	110	200	295	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:

For fixed-bias operation	25000 max.	ohms
For cathode-bias operation	Not recommended	

→ Typical CCS Operation with "Two-Tone Modulation":[p]

At 30 Mc

DC Plate Voltage	1000	1500	2000	volts
DC Grid-No.2 Voltage[n]	350	350	350	volts
DC Grid-No.1 Voltage[q]	-55	-55	-55	volts
Zero-Signal DC Plate Current	83	83	83	ma
Effective RF Load Resistance	1650	3000	4350	ohms
DC Plate Current at Peak of Envelope	250	250	250	ma
Average DC Plate Current	175	175	175	ma
DC Grid-No.2 Current at Peak of Envelope	30	30	30	ma

→ indicates a change.

Average DC Grid-No.2 Current . . .	6	9.5	15	ma
Average DC Grid-No.1 Current . . .	0	0	0	ma
Peak-Envelope Driver Power (Approx.) . . .	1	1	1	watt
Output-Circuit Efficiency (Approx.) . . .	95	95	95	%
Distortion Products Level:[r]				
Third Order . . .	29	29	30	db
Fifth Order . . .	40	38	35	db
Useful Power Output (Approx.):[s]				
Average . . .	55	100	147.5	watts
Peak Envelope . . .	110	200	295	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:
For fixed-bias operation. . . . . 25000 max. ohms
For cathode-bias operation. . . . . Not recommended

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1

Maximum CCS[f] Ratings, *Absolute-Maximum Values:*

	Up to 500 Mc	
DC PLATE VOLTAGE . . .	1500 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE . . .	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE . . .	-250 max.	volts
DC PLATE CURRENT . . .	200 max.	ma
GRID-No.2 INPUT . . .	8 max.	watts
GRID-No.1 INPUT . . .	2 max.	watts
PLATE DISSIPATION . . .	165 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode .	150 max.	volts
Heater positive with respect to cathode .	150 max.	volts

Typical CCS Operation:

At frequencies up to 175 Mc

DC Plate Voltage . . .	500	1000	1500	volts
DC Grid-No.2 Voltage (Modulated approx. 55%)[t] . . .	250	250	250	volts
DC Grid-No.1 Voltage[u] . . .	-100	-100	-100	volts
Peak RF Grid-No.1 Voltage . . .	113	113	113	volts
DC Plate Current . . .	200	200	200	ma
DC Grid-No.2 Current . . .	32	31	31	ma
DC Grid-No.1 Current (Approx.) . . .	6	6	6	ma
Driving Power (Approx.)[l] . . .	0.7	0.7	0.7	watt
Power Output (Approx.) . . .	50	140	235	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance
under any condition . . . . 25000 max. ohms

7203/4CX250B

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy[v]
and
RF POWER AMPLIFIER — Class C FM Telephony

Maximum CCS[f] Ratings, *Absolute-Maximum Values:*

	Up to 500 Mc	
DC PLATE VOLTAGE	2000 max.	volts
DC GRID-No.2 (SCREEN-GRID) VOLTAGE	300 max.	volts
DC GRID-No.1 (CONTROL-GRID) VOLTAGE	−250 max.	volts
DC PLATE CURRENT	250 max.	ma
GRID-No.2 INPUT	12 max.	watts
GRID-No.1 INPUT	2 max.	watts
PLATE DISSIPATION	250 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	150 max.	volts
Heater positive with respect to cathode	150 max.	volts

Typical CCS Operation:

At frequencies up to 175 Mc

DC Plate Voltage	500	1000	1500	2000	volts
DC Grid-No.2 Voltage	250	250	250	250	volts
DC Grid-No.1 Voltage	−90	−90	−90	−90	volts
Peak RF Grid-No.1 Voltage	109	109	109	109	volts
DC Plate Current	250	250	250	250	ma
DC Grid-No.2 Current	48	45	36	30	ma
DC Grid-No.1 Current (Approx.)	12	12	11	11	ma
Driving Power (Approx.)	1	1	1	1	watt
Power Output (Approx.)	65	180	290	400	watts

At frequency of 500 Mc with coaxial cavity

DC Plate Voltage	2000	volts
DC Grid-No.2 Voltage	300	volts
DC Grid-No.1 Voltage	−90	volts
DC Plate Current	250	ma
DC Grid-No.2 Current	10	ma
DC Grid-No.1 Current (Approx.)	25	ma
Driver Power Output (Approx.)[l]	18	watts
Useful Power Output (Approx.)	250	watts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	25000 max.	ohms

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

[b] With cylindrical shield JEDEC No.320 surrounding radiator; and with a cylindrical shield JEDEC No.321 surrounding the grid-No.2 ring terminal. Both shields are connected to ground.

[c] Available from Eitel-McCullough, Inc., San Bruno, California.

[d] Available from E. F. Johnson Co., Waseca, Minnesota.

[e] For use at lower frequencies.

[f] For use at higher frequencies.

[g] Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

[h] Continuous Commercial Service.

j Averaged over any audio-frequency cycle of sine-wave form.

k Averaged over any frame.

l The driver stage is required to supply tube losses and rf-circuit losses. The driver stage should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, in components, in initial tube characteristics, and in tube characteristics during life.

m "Single-Tone" operation refers to that class of amplifier service in which the grid-No.2 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

n Preferably obtained from a fixed supply.

p "Two-Tone Modulation" operation refers to that class of amplifier service in which the input consists of two equal monofrequency rf signals having constant amplitude. These signals are produced in a single-sideband suppressed-carrier system when two equal-and-constant-amplitude audio frequencies are applied to the input of the system.

q Obtained from a fixed supply.

r Without the use of feedback to enhance linerity.

s Measured at load of output circuit having indicated efficiency.

t The dc grid-No.2 voltage must be modulated approximately 55% in phase with the plate modulation in order to obtain 100% modulation of the 7203. The use of a series grid-No.2 resistor or reactor may not give satisfactory performance and is therefore not recommended.

u Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

v Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	2.3	2.9	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	–	0.06	μμf ←
Grid No.1 to cathode, grid No.2, and heater	2	14.2	17.2	μμf
Plate to cathode, grid No.2, and heater	2	4.0	4.8	μμf
Grid-No.1 Voltage	1,3,4,5	-32	-46	volts
Grid-No.2 Current	1,3,4,5	-7	3	ma
Useful Power Output	4,5,6	225	–	watts

Note 1: With 6.0 volts on heater.

Note 2: With cylindrical shield JEDEC No.320 surrounding radiator; and with a cylindrical shield JEDEC No.321 surrounding the grid-No.2 ring terminal. Both shields are connected to ground.

Note 3: With dc plate volts = 1000, dc grid-No.2 volts = 300, and grid-No.1 voltage adjusted to give plate current of 150 ma.

Note 4: With Forced-Air Cooling as specified under GENERAL DATA—*Air-System Socket*.

Note 5: Heater-voltage must be applied for at least 30 seconds before application of other voltages.

Note 6: With heater volts = 5.5, dc plate volts = 2000, dc grid-No.2 volts = 300, dc grid-No.1 volts = -90, dc grid-No.1 ma. = 25 maximum, grid-No.1 signal voltage adjusted to produce dc plate current of 250 ma., and coaxial-cavity amplifier-circuit operating frequency (Mc) = 475.

← Indicates a change.

SPECIAL TESTS & PERFORMANCE DATA

Interelectrode Leakage:

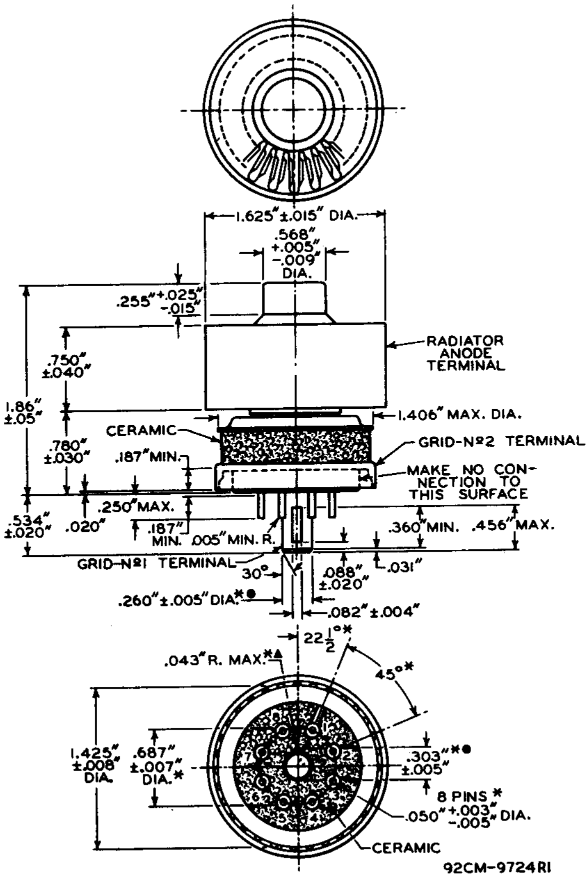
This test is destructive and is performed on a sample lot of tubes from each production run under the following conditions: ac heater volts = 6.6, no voltage on other elements, and specified forced-air cooling for *Air-System Socket*. At the end of 500 hours, with tube at 25° C, and with no voltage applied to heater, the minimum resistance between indicated electrodes as measured with a 500-volt Megger-type ohmmeter having an internal impedance of 2.5 megohms, will be:

Grid No.1 and grid No.2	10 min.	megohms
Grid No.1 and cathode	10 min.	megohms
Grid No.2 and cathode	10 min.	megohms

OPERATING CONSIDERATIONS

The *socket* for the 7203 should be of a type (such as is indicated in the tabulated data) which permits adequate air-cooling of the tube. Although the base will fit a conventional lock-in socket, the latter does not permit adequate cooling and its use is therefore not recommended.

The *plate connection* is made by means of a metal band or spring contacts to the cylindrical surface of the radiator. It is essential that the contact areas be kept clean to minimize rf losses especially at the higher frequencies.



GRID-No. I-PLUG DIMENSIONS ARE MEASURED BY THE USE OF THE SERIES OF GAUGES SHOWN IN SKETCHES G_1 AND G_2. IN THE FOLLOWING INSTRUCTIONS FOR THE USE OF THESE GAUGES "GO" INDICATES THAT THE ENTIRE GRID-No. I-PLUG KEY WILL ENTER THE GAUGE; AND "NO-GO" INDICATES THAT THE GRID-No. I-PLUG KEY WILL NOT ENTER THE GAUGE MORE THAN 1/16". INSTRUCTIONS FOR THE USE OF THE GAUGES FOLLOW:

▲,●,*: See next page.

▲ GAUGES G_1-1, G_1-2, G_1-3, AND G_1-4:

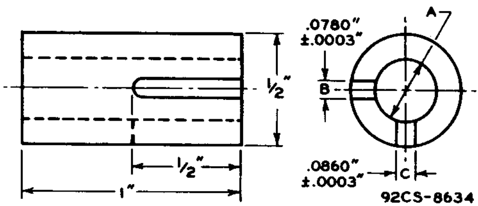
USING ONLY SLOT C, TRY THESE GAUGES IN NUMERICAL ORDER UNTIL ONE IS FOUND THAT WILL ACCEPT THE ENTIRE GRID-No.1 PLUG. USING THE FIRST GAUGE THUS FOUND, IT WILL NOT BE POSSIBLE TO INSERT THE GRID-No.1 PLUG IN SLOT B.

● GAUGES G_2-1, G_2-2, AND G_2-3:

THE GRID-No.1 PLUG WILL BE REJECTED BY GAUGES G_2-1 AND G_2-2, BUT WILL BE ACCEPTED BY GAUGE G_2-3.

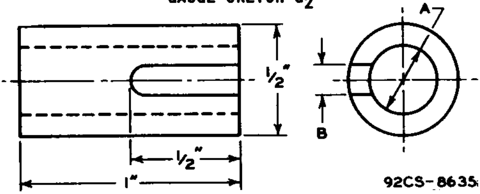
* BASE-PIN POSITIONS ARE HELD TO TOLERANCES SUCH THAT THE ENTIRE LENGTH OF THE PINS WILL, WITHOUT UNDUE FORCE, PASS INTO AND DISENGAGE FROM THE FLAT-PLATE GAUGE SHOWN IN SKETCH G_3.

GAUGE SKETCH G_1



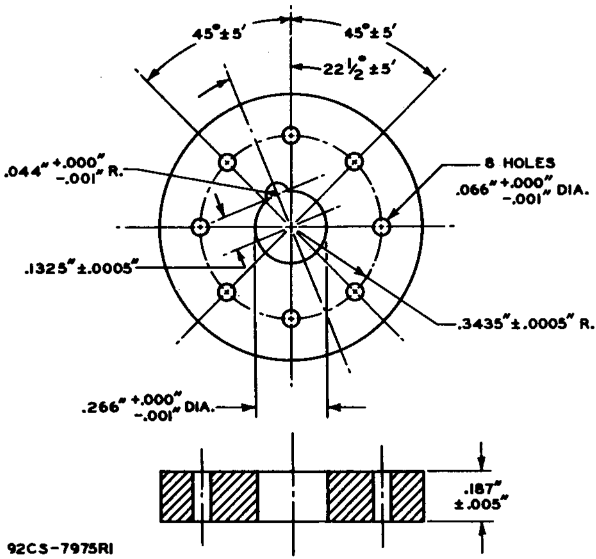
Gauge	Dimension A
G_1-1	.2575" + .0000" − .0005"
G_1-2	.2600" + .0000" − .0005"
G_1-3	.2625" + .0000" − .0005"
G_1-4	.2650" + .0000" − .0005"

GAUGE SKETCH G_2



Gauge	Dimension	
	A	B
G_2-1	.2550" + .0000" − .0005"	.125"
G_2-2	.2980" + .0000" − .0005"	none
G_2-3	.3080" + .0000" − .0005"	none

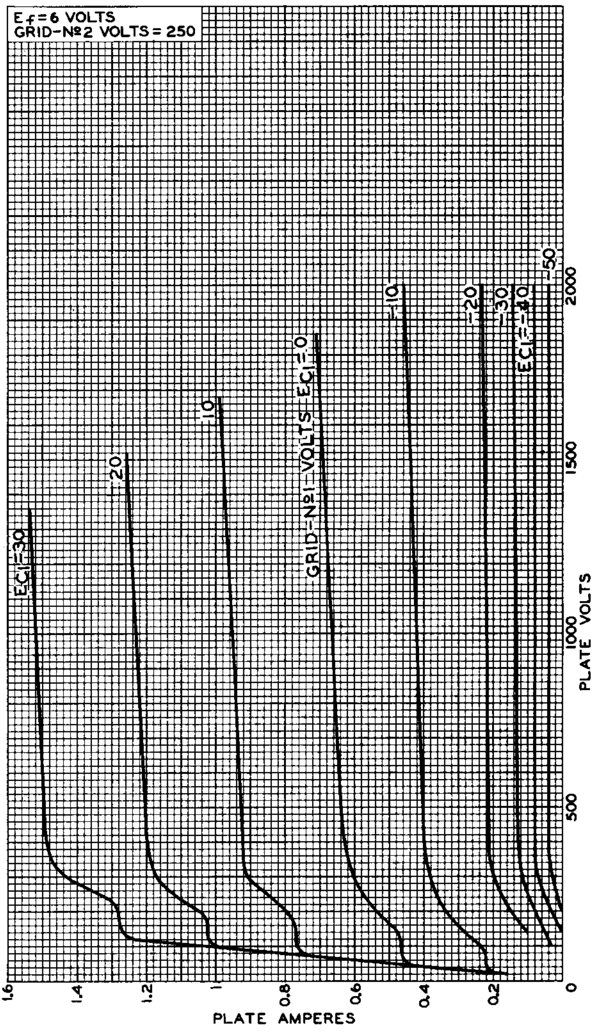
GAUGE SKETCH G_3



TOLERANCES ARE NOT CUMULATIVE

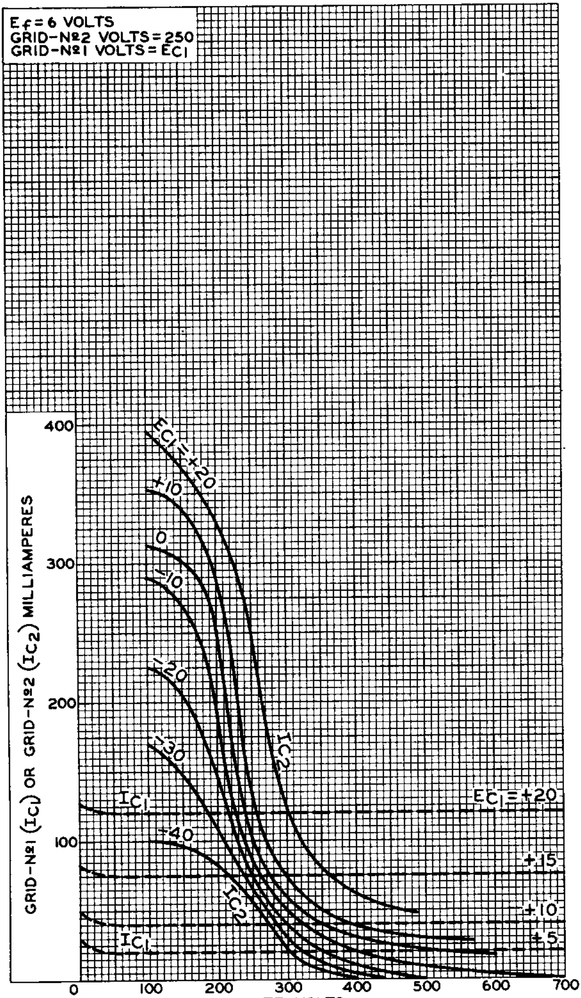
7203/4CX250B

TYPICAL PLATE CHARACTERISTICS



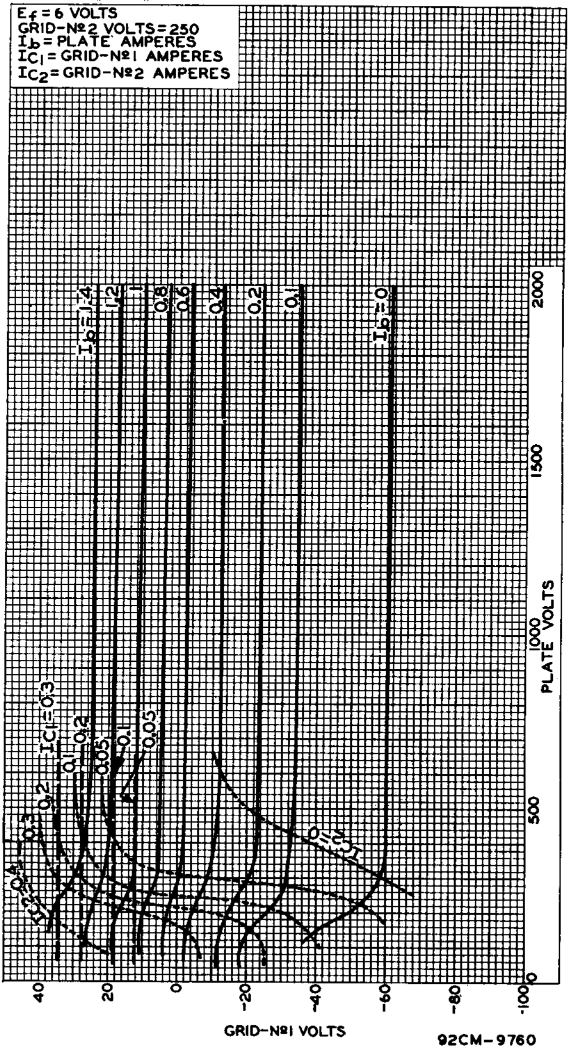
92CM-9755

TYPICAL CHARACTERISTICS



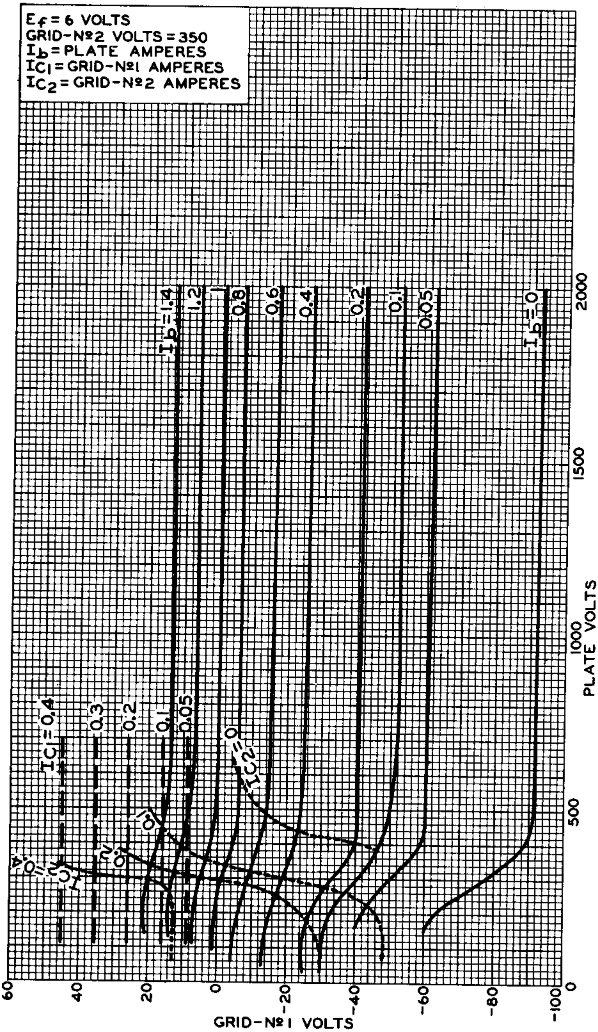
92CM-9756

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-9760

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-9761